

cross sectional view in FIG. 1B, and designated by the general reference character 100. The view of FIG. 1B is taken along line B-B of FIG. 1A.

[0039] An instrument 100 can have the same general shape of a known percussion instrument, and in the very particular example of FIGS. 1A and 1B can have the shape of a “tom” type drum. An instrument 100 can include a body 102 and a playing surface 104 supported by the body 102, and a controller assembly 110.

[0040] A playing surface 104 can include one or more capacitance sensors that can provide a capacitance that can vary in response to a percussive event. In the example of FIGS. 1A and 1B, instrument 100 can include membrane sensors (one shown as 106-0) that can occupy locations of a membrane (i.e., skin or drumhead) in a conventional acoustic drum, as well as rim sensors (one shown as 106-1) that can occupy locations of a rim in a conventional acoustic drum. Capacitance sensors (e.g., 106-0 and 106-1) can be connected by a signal path 108 to inputs of a controller assembly 110.

[0041] It is understood that while FIGS. 1A and 1B show a particular shape, number, and tiling of capacitance sensors (e.g., 106-0 and 106-1), such an arrangement is intended to serve as but one example of possible variations.

[0042] A controller assembly 110 can include capacitance sensing and processing circuits that generate sound, position and/or other indications in response to a percussive event on playing surface 104. A controller assembly 110 is preferably attached to body 102, but can be located remote from a body 102. A controller assembly 110 can sense a capacitance for multiple capacitance sensors in a multiplexing fashion, selectively connecting different capacitance sensors to a common sense node. Such an arrangement can provide an advantageously a compact input sensing circuit, as compared to conventional arrangements that can include a dedicated processing circuit for each capacitance sensor.

[0043] It is noted that a percussive event can vary between applications. For example, in some applications a percussion event can be the striking of the playing surface with an object, such as a drumstick, mallet, or brush, but in other arrangements could include the tapping of a finger. Differentiation between such events can be established by setting different threshold values utilized in a capacitance sensing method. Further, and as will be described below, percussive events can be filtered according to various criteria to determine a valid input event, including but not limited to, a speed at which an object approaches/contacts a playing surface and/or a force with which an object strikes a playing surface.

[0044] As will be described in more detail below, outputs from an instrument, such as that shown in FIGS. 1A/1B and various embodiments described below, can take various forms. As but a few of the many possible examples, outputs can be an audio signal in analog or digital form. Alternatively, outputs can be in a predetermined digital music format, such as that of the musical instrument digital interface (MIDI). Outputs can also be in a format suitable controller applications, such as input devices to personal computers (PC), gaming consoles, or like applications.

[0045] In this way, a capacitance value for multiple sensors on a playing surface of a percussion instrument can be monitored for percussive events.

[0046] While FIGS. 1A and 1B show one particular instrument shape, this should not be construed as limiting the

invention thereto. Alternate embodiments can take various other arbitrary shapes. A few of the many possible examples are shown in FIGS. 2-5.

[0047] Referring now to FIG. 2, a percussion instrument according to a second embodiment is shown in a side cross sectional view, and designated by the general reference character 200. Percussion instrument 200 can include some of the same general sections as FIGS. 1A and 1B, thus like sections are referred to by the same reference character but with the first digit being a “2” instead of a “1”.

[0048] FIG. 2 shows an instrument having the shape of a cymbal, such as a “crash” or “ride” cymbal. As is well known, a typical cymbal has a disc-like shape with a raised bell area in a central region. The embodiment of FIG. 2 can differ from that of FIGS. 1A and 1B in that it can include multiple playing surfaces on different sides of the instrument.

[0049] In the very particular example of FIG. 2, instrument 200 can include a first playing surface 204-0 formed on a top side of the cymbal shape, a second playing surface 204-1 formed on an edge of the cymbal shape, and a third playing surface 204-2 formed on a bottom side of the cymbal shape. Each different playing surface (204-0 to 204-2) can include one or more capacitance sensors, and can provide different inputs to a controller assembly 210. Thus, a percussive event can be distinguishable according to surface of an object.

[0050] As but a few examples, single or multiple percussive events on any of playing surfaces (204-0 or 204-2) can result in a different sound value being encoded or generated. Further, simultaneous percussive event on two such playing surfaces, can result in a different type of sound event. Even more particularly, a simultaneous touch event on playing surfaces of opposing sides (e.g., 204-0 and 204-2) can generate a sound dampening, or ending event. More detailed examples of such operations will be described below.

[0051] In this way, capacitance values for sensors of multiple playing surfaces of a percussion instrument can be monitored for percussive events.

[0052] Referring now to FIG. 3, a percussion instrument according to a third embodiment is shown in a side cross sectional view, and designated by the general reference character 300. Percussion instrument 300 can include some of the same general sections as FIG. 2, thus like sections are referred to by the same reference character but with the first digit being a “3” instead of a “2”.

[0053] FIG. 3 shows an instrument having the shape of a “hi-hat” type cymbal. As is well known, a typical hi-hat cymbal arrangement includes cymbals physically positioned in opposition to one another, with one or both such cymbals being capable of moving into contact with the other to generate a sound.

[0054] In the particular example of FIG. 3, instrument 300 can include a top cymbal structure 301 that can include the same components as instrument 200. Top cymbal structure 301 can be brought down into contact with a bottom symbol structure 303. In such an arrangement, playing surface 304-2 can detect such an event to generate a sound indication. A signal path 308 can travel within a flexible wiring to enable travel of the top cymbal structure 301.

[0055] In this way, capacitance sensors can detect one part of a percussion shaped, or percussion-like object coming into contact with another part.

[0056] Referring now to FIG. 4, a percussion instrument according to a fourth embodiment is shown in a side cross sectional view, and designated by the general reference char-